***National Regional Sediment Management Demonstration Program, South Pacific Division, State of California***

***April 2002***


US Army Corps of Engineers®

***National Regional Sediment Management Demonstration Program, South Pacific Division, State of California April 2002***

***National Regional Sediment Management Demonstration Program, South Pacific Division, State of California***

## *Introduction*

Although the term “regional sediment management (RSM)” is new, recognition of the regional nature of coastal processes and the regional influence of engineering works is not. The inter-relationship between coastal navigation projects and contiguous beaches became a Federal interest at least as early as the 1930s (Brooke, 1934)

In the past, the U.S. Army Corps of Engineers (USACE) has focused on managing sand at coastal projects on a project-by-project basis. This approach to sand management may not adequately consider the impact of individual projects on down drift projects. To address this issue, the USACE has initiated efforts to assess the benefits of managing sediment resources as a regional scale resource rather than a localized project resource. This concept of Regional Sediment Management (RSM) is a result of the 67$^{th}$ meeting of the Coastal Engineering Research Board held in May 1998.

Today the USACE is pursuing RSM by collaborating with local and state governments to manage sediments over regions encompassing multiple projects. In October 1999, the Corps began a RSM demonstration program for the Northern Gulf of Mexico, which is directed by the Mobile District. In November 2000, five additional demonstration sites were initiated:

- Northeast Florida (Jacksonville District)
- New Jersey Shore (Philadelphia District)
- South Shore of Long Island (New York District)
- Southeast Lake Michigan (Detroit District)
- Southern California (South Pacific Division).

This report will focus in the RSM demonstration project initiatives in the State of California (South Pacific Division).

## *Program Goals*

The goal of the demonstration program is to change the paradigm of project specific management to focusing on a regional approach in which the USACE as well as state and local agencies stop managing projects and begin "managing the sand." The objectives of the demonstration program are:

- ❖ Develop and implement a Regional Sediment Management Plan as part of the California Coastal Sediment Management Master Plan for the State of California in conjunction with state and local partners
- ❖ Include regional coastal program performance by developing an effective comprehensive statewide approach to solve complex sediment problems of shorelines, coastal wetlands and coastal watersheds.
- ❖ Identify sources and quantify the regional statewide sediment budget.
- ❖ Develop centralized GIS Database for use by all regional stakeholders

## *Program Authority*

- WRDA Section 227, Subsection 4 ... authorizes the Corps to ”... cooperate with any State in the preparation of a comprehensive State or regional plan for the conservation of coastal resources located within the boundaries of the State."
- 33 CFR Part 337.9 ... directs that, "District engineers should identify and develop dredged material disposal management strategies that satisfy the long-term (greater than 10 years) needs for Corps projects.”

## *Program Goals*

The program goals for FY01/02 were:

1. Develop and implement a Regional Sediment Management Plan as part of the California Coastal Watersheds Master Plan for the State of California in conjunction with state and local partners.
2. Improve regional coastal program performance by developing an effective, comprehensive statewide approach to solve complex sediment problems of shorelines, coastal wetlands and coastal watersheds.
3. Identify sources and quantify the regional statewide sediment budget.
4. Develop centralized GIS Data Base for use by all regional stakeholders.

## *Project Location and Description*

The Regional Sediment Management Demonstration initiative in California region encompasses approximately 1,770 kilometers (1,100 miles) of shoreline along the Pacific Ocean. The State of California, the third largest state in the United States, has a total area of 411,469 sq km (158,869 sq mi), including 6,926 sq km (2,674 sq mi) of inland water and 575 sq km (222 sq mi) of coastal waters and over which it has jurisdiction.

The State of California’s shoreline is comprised of sandy beaches, rocky headlands, scenic coastal bluffs, estuaries and coastal wetlands. The unique geography, diverse climate zones and strategic economic position on the Pacific Rim drives the State population’s strong desire to live, work and recreate along the shoreline. With 85% of the population living within 50 miles of the coast, urbanization pressures have seriously impacted natural coastal resources. Flood control, navigation and water supply projects can adversely impact the coastal zone by impeding the continuation of natural sediment movement through our streams, rivers and watersheds. In order to restore and preserve our remaining coastal shorelines, wetlands and watersheds, there is a need to develop a comprehensive master plan that utilizes a regional systematic approach to resolving coastal sediment management issues.

With 12 physiographic regions from high mountains, foothill woodland, chaparral, moist forests, and an alternating rocky and sandy coast, California has high topographic diversity, including the highest land in the contiguous 48 states (Mt. Whitney--4,406 meters). Huge differences in daily and annual temperatures, precipitation, and evaporation have led to strongly differing vegetation patterns and centers of plant endemism. Where rivers and smaller drainages reach the coast, there may be protected bays, salt marshes, and coastal dunes. (http://biology.usgs.gov/s+t/SNT/noframe/ca162.htm)

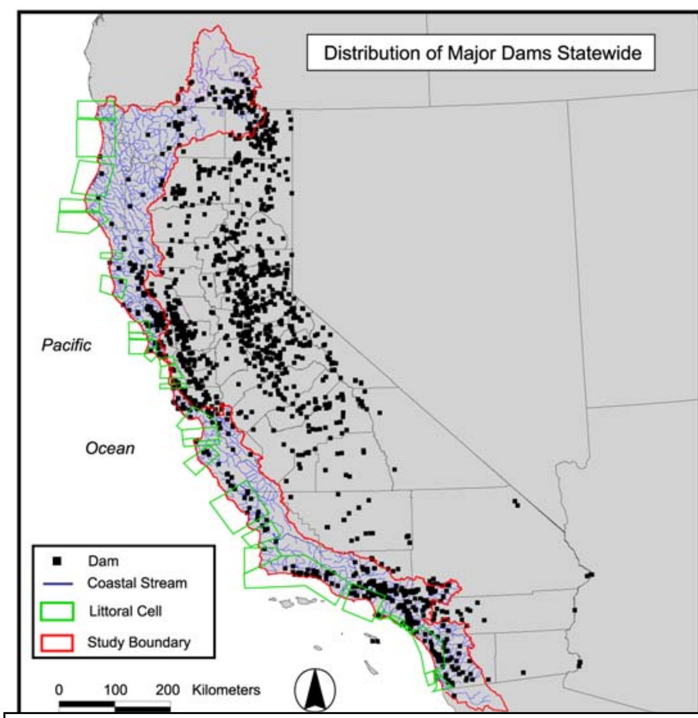


*Figure 1 Distribution of Major Dams Statewide from Willis 2001*

In the past, the dominant transport of sediments to the coast has been rivers and streams. These were the conveyor belts that moved sediment from the mountains and uplands to the lowland basins and nearshore systems. However over the last thirty to forty years most of the rivers have been tamed through the construction of large dams, (more than 1,200) trapping all but the finest sediments from being transported downstream.

Damming rivers has decreased the sand supply by more than 50 percent. As a result, the California beaches have undergone substantial erosion since. Only in Northern California is there a constant supply of sediments to the nearshore as there was no need to dam the streams and rivers in the early days and they are currently protected under the Wild and Scenic Rivers Act of 1972. (Kenzer, et al., 1992)

Other impacts from decreased sediment supply are to the tourism industry and Californian's quality of life. As much as 85 percent of the state's population lives within 80 kilometers (50 miles) of the coastline. This results in a significant urbanization pressures which is seriously impacting coastal resources.

Not only the residents but visitors in general enjoy California's beaches; more than 100 million visitors come to California beaches each year - 60 million in los Angeles county alone- generating millions of dollars in taxes to local, state and federal agencies. (Kenzer, et al., 1992)

*Figure 2. California Beaches Visitors*

California is now the eighth ranking economy in the world, comparable to Mainland China and larger than Brazil, Canada and Spain. In 1997, California's gross product exceeded the trillion-dollar mark making it the first state to achieve this record. In 2000, California was the first state to top $1 trillion in personal income (California Department of Finance).

In 1997 and 1999, California State Department of Boating and Waterways (DBAW) commissioned San Francisco State University to ascertain the impact of beaches on California's economy. In 1995, the survey estimated that the State's beaches were responsible for $10 billion in direct spending (updated in 1998 to $14 billion), $1 billion in state taxes and more than 500,000 jobs. The spending was almost 3 percent of economic activity in the State in 1995. Beach-related jobs constituted 3.5 percent of the State's employment. (King and Potepan, 1997) This data is significant at both the Federal and State levels. The study demonstrated that protecting California coastal resources is directly related to the economy's strength and Federal benefits (California's Balance of Payments with the Federal Treasury FY 81-99 The California Institute for Federal Policy Research).

In order to preserve and restore our remaining coastal shorelines wetlands and watersheds there is a need to develop a comprehensive master plan that utilizes a regional systematic approach to resolving coastal sediment management issues.

## *Demonstration Initiatives*

California continues to be involved in various components of Regional Sediment Management. Some of these activities include:

1. Beach quality sediments dredged from coastal navigation channels are deposited on downcoast beaches to help foster bypassing of sediments around harbor entrance structures.
2. The Coast of California Storm and Tidal Wave Studies have been completed for San Diego and Orange counties and have been initiated for Los Angeles and Santa Barbara/Ventura Counties.
3. Continued partnership between the Corps and the California Resources Agency to coordinate coastal shoreline and watershed restoration, protection and enhancement efforts with local, state and federal stakeholders and programs. The participants in this Coastal Sediment Management Workgroup include the Corps' South Pacific Division, the San Francisco and Los Angeles Districts, the California Resources Agency, the CA Department of Boating and Waterways, the CA Dept. of Fish and Game, the CA State Lands Commission, the CA Coastal Commission, the CA State Coastal Conservancy, the CA Dept. of Parks and Recreation, and CalCoast, an advocacy organization representing many coastal cities and counties.

**Coastal Sediment Management Workgroup**

The California Sediment Management Workgroup (CSMW) was established as a partnership between the USACE and the California Resources Agency to facilitate regional approaches to protecting, enhancing and restoring California's coastal beaches and watersheds through Federal, State and local cooperative efforts. The CSMW goals are to:

- Coordinate California's coastal beach and watershed restoration, protection and enhancement efforts with local, State and Federal stakeholders and programs;
- Better coordinate coastal sediment management and beach nourishment activities with related ongoing coastal watershed management, habitat

restoration and protection, water quality enhancement, resource sustainability, and urban waterfront planning efforts;

- Identify components necessary to develop collaborative approaches to well conceived environmentally-sound coastal sediment and watershed management projects; and
- Increase awareness of state and federal coastal beach and watershed protection, restoration and enhancement policies, programs and activities among local and regional governments.

The ultimate goal of the CSMW is provide coastal beach and watershed management. Key to achieving this goal is creating a comprehensive, statewide, Coastal Sediment Management Master Plan that has the support of the member agencies and stakeholders. For this purpose the CSMW organized a series of public workshops along the California coast and meets regularly to maintain involvement by all participating agencies (http://www.spd.usace.army.mil/csmwonline/CSMW_Introduction.pdf).

Participants in this Sediment Management Workgroup include the Army Corps of Engineers South Pacific Division, the San Francisco and Los Angles Districts, the California Resources Agency, the CA Department of Boating and Waterways, the CA Department of Fish and Game, the CA State Lands Commission, the CA Coastal Commission, the CA State Coastal Conservancy, the CA Department of Parks and Recreation and CalCoast, an advocacy organization representing many coastal cities and counties.

For more detail information about the ongoing projects and achievements of the CSMW please refer to Appendix "A", which contains the initial report released by the CSMW in November 2000. The following sections are only abstracts or reproduction of the original documents referenced.


*Figure 3 Some members of the CSMW.*

**California Coastal Sediment Management Master Plan**

The California Coastal Sediment Management Master Plan will evaluate and prioritize the statewide coastal sediment management needs with the focus on the ecological functions of California's coastal watersheds, wetlands, and beaches. In addition, the Master Plan will identify the means to restore and manage high priority coastal wetlands and beaches with the goal of enhancing and preserving these valuable assets.

The Master Plan, will for the first time, identify, evaluate, and prioritize sediment management approaches in a framework that addresses natural and man-made influences on sediment sources, transport, and deposition.

*Figure 4 Sediment management in debris basin by Reyes Construction*

The Master Plan is divided in three phases, the first phase "Plan Development" will focus on the main key issues, such as public involvement in problem and opportunities identification, collection and assessment of existing data, development of communication and information sharing resources among agencies, and prioritization of projects according to management needs and available resources.

The first phase of Master Plan development will in Fiscal Year 2002 with the implementation of the five highest priority master plan development tasks. Subsequent phases of master plan development will include filling data gaps identified in the first phase, establishment of institutional partnerships and coordination in coastal sediment management projects, and identification and development of funding sources for long-term implementation of regional sediment management strategies. (CSMW, 2001)

## Phase I

The first phase of Master Plan development consists of five major tasks:

- Scoping of problems and objectives
- Data collection and analysis
- Development of a GIS database
- Establishment of information access resources
- Development of a list of priority projects.

*Scoping Problems and Objectives*

Scoping of California coastal sediment management problems and objectives will be done through public outreach and consultation with expert informants. Public outreach will be conducted through regional and local workshops that will publicize development of the master plan and provide stakeholder input into master plan formulation, building on the information gathered from the 2001 scoping workshops. Expert informants from Federal, state, and local agencies, academia, non-governmental organizations, and the private sector will be recruited early in the process to assist in the determination and prioritization of problems and objectives.

Master plan objectives should reflect a holistic approach to developing solutions to priority problems that incorporates multi-agency coastal sediment management efforts that consider the interconnectedness and dynamics of natural systems and the influences of human activities. Master plan objectives will be conceived from a multi-system perspective that addresses the relationships among watersheds, wetlands, and beaches.

## *Data and Information Collection*

The data and information collection effort will characterize California coastal sediment systems using existing and ongoing studies. The initial step will be to catalogue existing reports and ongoing studies for specific coastal sites and regional studies. Specifically, the collection effort will focus on the physical properties of coastal sediment systems, affected natural resources, and regulations and policies that impact sediment management. In addition, data gaps will be identified and used as guidance for subsequent data collection efforts.

Coastal sediment system characterization includes an inventory and assessment of sand sources (wetland restoration projects, coastal bluffs, opportunistic sand projects, port and channel dredging, inland sources, and offshore sites); fluvial and estuarine barriers to sediment transport (jetties, groins, dams, transportation infrastructure, mines, etc.); natural and artificial littoral barriers (headlands, reefs, submarine canyons, etc.); fluvial and littoral physical processes; coastal geomorphological changes; and coastal sediment budgets.

*Figure 5 Lake Hodges California, Accumulation average is 130,000 cy/yr*

*Regional Sediment Management GIS Database Development*

A GIS database will be developed as the central depository of geo-referenced sediment management data to serve as the basis of many analytical tasks conducted during development of the master plan and during implementation of priority projects. Determination of database host and maintenance responsibilities are two key issues that must be resolved to ensure effective application of GIS tools and analysis. A significant component of the data-gathering task identified above will be the collection, quality review, and assembly of existing GIS data. All original data collection will utilize geo-referencing to the fullest extent possible to ensure the broadest application of GIS based tools and analysis.

*Tasks include:*

A. Prepare for collecting data and information

- ❖ Identify list of data and information types and attributes to be collected (see attached list). The draft list will be used during the agency and public workshop process (see Work Element 2.B).
- ❖ Obtain approval of list of data and information types from CSMW.
- ❖ Establish data quality and format standards for each data type.
- ❖ Establish metadata and error analysis standards and procedures.
- ❖ Develop a Technical Memorandum based on the results of this task.

B. Collect data and information (Contractor).

- ❖ Search for, evaluate, and compile data into GIS. Coordinate with existing data compilation efforts (such as the Southern California Wetlands Recovery Project and various Resources Agency projects)
- ❖ Prepare FGDC-compliant metadata in HTML and error analysis documentation.
- ❖ Construct a CERES-compatible metadata catalogue and upload it to CERES (www.ceres.ca.gov).

C. Prioritize data gaps (Project Manager and GIS Contractor)

- ❖ If necessary, identify and prioritize significant data gaps
- ❖ Evaluate opportunities to fill significant data gaps

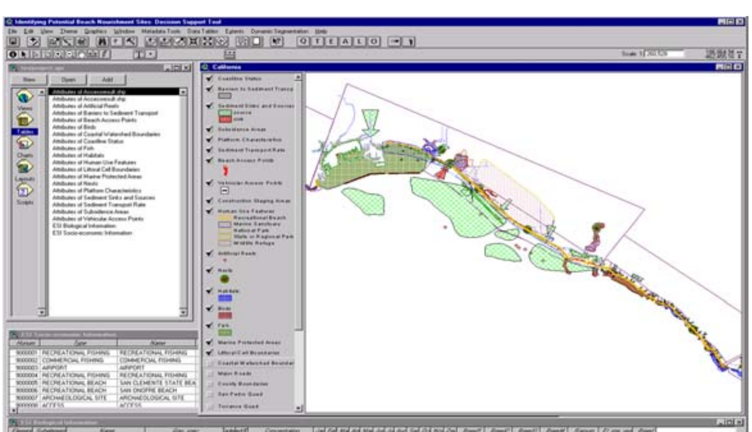

*Figure 6.*

*GIS Interactive Map and Database (M. Coyne)*

*Information Dissemination*

Information dissemination will be conducted through the institutionalization of inter- and intra- agency networks, development of a GIS-based Internet map server, and public information outreach.

Establishment of these networks will support subsequent phases of master plan development and will be instrumental for master plan implementation.

A GIS-based Internet map server will be developed to ensure agency and stakeholder access to GIS-based tools and analysis. The Internet map server will be linked to the coastal sediment management master plan website that will be developed for general public and agency use.

The main purpose of the coastal sediment management master plan website will be to educate and update government agencies, non-government organizations, and the public about coastal sediment systems. The website will be a focal point of internet based communication for all coastal sediment management related issues, agencies, and stakeholders. Determination of server residence and website maintenance are critical issues that must be resolved, as has been noted for other shared information resources.

### *Priority Project List Development*

Existing research and on-going studies have identified sediment management "hot spots" and recommended actions for local projects. The scooping of problems and objectives and the public outreach components of the first phase of master plan development also will identify priority locations and problem activities. During the first phase of master plan development, these existing analyses and prioritized projects will be evaluated from a regional perspective to assess potential solutions based on environmental impacts, cultural impacts, and economic benefits and costs.

The prioritized list developed during the first phase of master plan development will be the basis for a more extensive and inclusive list of coastal sediment management and restoration needs.

## Phase II

Phase II will build upon the tasks performed in the Phase I and included:

- ❖ Filling Data Gaps
- ❖ Policy and Regulation Assessment
- ❖ Establishment of Project Partnerships
- ❖ Establishment of Project Funding Sources

## Phase III

Phase III will assess existing sediment transportation infrastructure and the regional impacts of coastal sediment management. The purpose is to identify potential mechanisms for transporting sediment long distances, especially for sediments trapped behind a natural or man-made barrier.

Regional sediment impact analyses will assess the regional impacts of sediment management on recreation, habitat, economics, and real estate. Phase III will include an assessment of relationships between sediment management and relative sea level rise and climatic changes.  As with Phase II, Phase III will provide information to update the priority projects list and to update public information and education resources. The major tasks of the second phase of development include:

- ❖ Sediment Transportation Infrastructure Assessment
- ❖ Regional Sediment Management Impact Analyses
- ❖ Relative Sea Level Rise And Climatic Changes

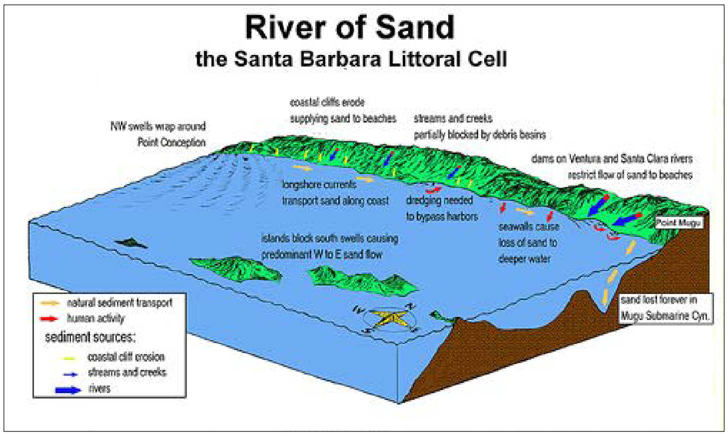


*Figure 7 Santa Barbara littoral cell as example of regional approach  (P. Jenkins)*

More detailed information for Phases II and III, refer to Appendix B that includes the current draft of the “California Master Plan for Comprehensive Coastal Sediment Management, Scoping Document with Task Descriptions”.

**<u>AB64 Report ”Increasing Natural: Sediment Supply to the Coast of California: Assessment and Recommendations”</u>**

In 1997, public polls in Southern California in regards to beach issues clear showed that California’s beaches are inextricable linked with its culture and identity. The status of the beaches had become one of the main concerns among coastal residents even over issues as pollution and public safety (The Primacy Group, 1998).

The research presented during 1998 California Shore and Beach Association (CSBPA), California Coastal Coalition (CalCoast) and American Coastal Coalition (ACC) reveled very low Federal and State funding dedicated to beach maintenance and compelled elected officials to take a stronger interest in remedying the problem and developing initiatives to create a state beach restoration program.

In 1999, this program was funded by a legislative bill known as “The California Public Restoration Act” AB64 to be administrated by the California Department of Boating and Waterways.  The bill was passed by the Assembly and Senate with a regional spending formula, as well as a requirement that DBAW and the CA State Coastal Conservancy study ways to restore the natural flow of sediment, including the removal of structures such as groins, dams and jetties where possible.

The main tasks of this study were to analyze:

- ❖ Impediments to fluvial delivery of sediment to the shoreline
    - ▪ Overview of Fluvial Sediment Supply

- Overview of Dams in California that included types, jurisdiction, impacts on sediment supply, portion of drainage basins impacted, and reduction in river sediment load
- Inventory of Debris Basins in coastal watersheds and Impacts on sediment supply
- Inventory and impacts of channelized streams

❖ Impediments to sediment delivery to the shoreline from coastal cliff erosion

- Inventory, extent and composition of sea cliffs along the coast
- Types of sea cliff erosion/ failure mechanisms Coastal cliff erosion in Oceanside and Santa Barbara littoral cells.
- Contributions to sediment budget
- Height of cliffs of sediment-supplying composition
- Cliff erosion rate information
- Impacts of armoring on sediment supply from cliffs in this littoral cells

❖ Recommended actions to increase natural sediment supply to the shoreline

- Prioritization of problem sites
- Impact to local sediment budget from elimination of problem
- Recommended plan actions such as structures to be removed, procedures to be changed, effects of no-action, etc.

The research portion of this study had been concluded and the final draft is currently under revision by the California Resources Agency and the Governor's office. Preliminary results were presented in November 2001 at the CalCoast and CSBPA "Restoring The Beach": Science, Policy and Funding Conference.

**<u>Impediments to fluvial delivery of sediment to the shoreline by Dams and Debris Basins</u>**

The study produced for the California Coastal Conservancy determine the significance of dams and debris basins as impediments to fluvial sediment delivery (Sherman, et al., 2001). The study showed that the sediment budgets of southern California beaches have been dominated by fluvial contributions and have been significantly decreased by dams and debris basins.

Extensive alteration of the fluvial systems by the construction of dams and debris basins has led to the impoundment of much of the natural sediment load, thereby reducing the amount of sand reaching the coast.

There have been several attempts to quantify these impacts via stream discharge modeling to represent natural and altered conditions. However, minimal work has focused on estimating sedimentation rates based on direct measurement of accumulations behind dams in coastal watersheds.

*Figure 9. Los Angeles River riverbed by G. DeVerteuli*

There are about 500 large dams in California's coastal watersheds. Fifty-three of these dams have sediment production areas exceeding approximately 7,770 hectares (30 square miles). Using a sediment production rate of 1,400 cubic yards per square mile (a high production rate for southern California), 30 square miles is the minimum area needed to produce 40,000 cubic yards per year, a quantity large enough to represent a significant impact on a coastal sediment budget.

This study focused on a subset of these dams that was selected based upon proximity to the coast, absence of downstream dams, and the characteristics of the coast at the river mouth (e.g., dams on streams draining to San Diego Bay were excluded). Twenty-five dams met these criteria: two each in Monterey and Santa Barbara Counties, three in Ventura County, eight in Los Angeles County, one each in San Luis Obispo and Orange Counties, and four each in Riverside and San Diego Counties.

Table 1 shows the amount of sediment impounded by the mayor dams selected under study criteria.

| **Table 1. Sediment impounded by selected mayor dams by Watershed** | |
|---|---|
| Los Angeles River Watershed | |
| Big Tujunga | 230,000 $yd^3/yr$ |
| Devil's Gate | 120,000 $yd^3/yr$ |
| Hansen | 420,000 $yd^3/yr$ |
| Total | 770,000 $yd^3/yr$ |
| San Gabriel River Watershed | |
| Puddingstone | 50,000 $yd^3/yr$ |
| San Gabriel | 77,000 $yd^3/yr$ |
| Santa Fe | 200,000 $yd^3/yr$ |
| Total | 327,000 $yd^3/yr$ |
| Santa Ana River Watershed | |
| Prado | 1,130,000 $yd^3/yr$ |

(Sherman, et. al., 2001)

Sedimentation data were not obtained for three of the dams, and another six had sedimentation rates less than 20,000 cubic yards per year. These dams were not considered further. The remaining 16 dams impound an average of about 6,750,000 cubic yards per year of sediment. It is estimated that about 25 percent of this volume is of a sand size suitable for southern California beaches. This represents a substantial reduction in fluvial sand transport, and is a volume large enough to directly and indirectly increase erosion rates in particular littoral cells. Table 2 shows the dams with larger impoundment rates.

| Table 2. Dams with Large Impoundment Rates (Greater than 50,000 cubic yards per year) | |
|---|---|
| Bradbury Dam | 580,000 $yd^3$/yr |
| El Capitan Dam | 160,000 $yd^3$/yr |
| Lake Hodges | 130,000 $yd^3$/yr |
| Prado | 1,130,000 $yd^3$/yr |
| Santa Felicia Dam | 500,000 $yd^3$/yr |
| Twitchell Dam * | 1,730, 000 $yd^3$/yr |

(Sherman, et. al., 2001)

The potential loss of beach sand by reservoir impoundment exceeds the estimates obtained by river discharge models. Part of the difference can be attributed to sediment storage within the drainage system and on the alluvial plain. Nevertheless, the net impact is substantial. The magnitude of human impact is large enough to warrant intervention to restore sediment supply to beaches. The nature of the intervention depends on the characteristics of individual dams – their purpose, condition (see Table 3), quantity and quality of impounded sand, distance from the coast, and the magnitude of local beach erosion. Alternatives to mitigate sediment trapping by dams include dam removal, dam bypassing, sand hauling, and the provision of sand credits.

| Table 3. Dams where design function is substantially impaired (25% < capacity lost) | |
|---|---|
| Hansen Dam | 71% remains |
| Los Padres Dam | 67% remains |
| Matilija Dam | 7% remains |
| San Clemente Dam | 10% remains |
| Twitchell Dam* | 71% remains |

(Sherman, et. al., 2001)

**Impediments to sediment delivery to the shoreline from coastal cliff erosion**

Sea cliff erosion contributes to the natural sediment supply to California's beaches therefore when an armoring structure (i.e. riprap, seawall) is built in front of a seacliff to hinder erosion and thus protect bluff-top development, the natural supply of sand from cliff erosion is cut off. Thus, it is imperative to inventory the extent of eroding seacliffs along the coast of California and the degree to which they are armored to determine the human impact on natural sediment supply to the coast.

The majority (72 percent or 792 miles) of the coast of California consists of actively eroding sea cliffs. More specifically, 13 percent of the coastline is high relief, steep cliffs or mountains that contribute a negligible amount of sand to the littoral budget, and 59 percent of the coastline is low relief (less than 300 feet) wave-cut bluffs or terraces that, through erosion, produce a greater percent of sand-sized material to the littoral budget than the high relief, steeply cliffed coastline. Using digital video of the California coast from 1998, it was determined that approximately 105 miles of the state's coastline (10 percent) are presently armored; 66 miles (63 percent) of this armoring are protecting beaches, harbors, low bluffs, and dunes while the remaining 39 miles (37 percent) of the armoring are protecting sea cliffs.

*Figure 10. Hi Relief Steep Cliffs south of San Francisco. (Runyan, 2001)*

To assess the direct impact of coastal armoring on the contribution of littoral sediment from bluff erosion, two littoral cells were chosen for detailed investigation. The Oceanside and Santa Barbara cells were selected to provide a littoral cell-specific sand budget analysis, including the pre-development budget and the extent of human impact on the budget. The annual production of littoral sand from a segment of shoreline through sea cliff erosion is the product of the cross-sectional area of sea cliff (Area = alongshore cliff length times cliff height), the average annual rate of cliff retreat (feet/year), and the percentage of the material that is littoral-sized in the bedrock and the capping terrace deposits.

In the Santa Barbara Cell, 11 miles or 14 percent of the cliffs in the cell have now been armored. Coastal bluff erosion naturally provided approximately 14,000 cubic yards per year of littoral-sized sand; this has been reduced 19.3 percent to 11,300 cubic yards per year through the emplacement of coastal armoring (Table 1). This represents a reduction of 2,700 cubic yards per year. In the Oceanside Cell, seven miles, or 20 percent, of the bluffs in the cell have now been armored. Bluff erosion prior to the emplacement of seawalls and riprap contributed 67,300 cubic yards per year, and this has been reduced to 54,900 cubic yards per year due to bluff armoring. Thus, armoring has reduced the sand input to the cell by approximately 12,400 cubic yards per year.

Overall, bluff erosion plays an insignificant role as a source of sand for the Santa Barbara littoral cell in particular. The total amount of sand supplied to the beaches by bluff erosion, whether under natural or actual conditions, is less than 1 percent of the total littoral budget for this cell. This is due in large part to the low percentage of sand in most of the bluff materials and the relatively low historic rates of bluff retreat. Removing rip-rap or seawalls as a mechanism for increasing the natural sand supply to the shoreline is not a worthwhile approach in this area; the potential sand augmentation is insignificant in the overall littoral budget and the associated impacts of removing armor far outweigh the very minor benefits that would be achieved. While there are impacts of coastal armoring (visual, access, etc.), they do not include significant impacts on the littoral budget of this cell.

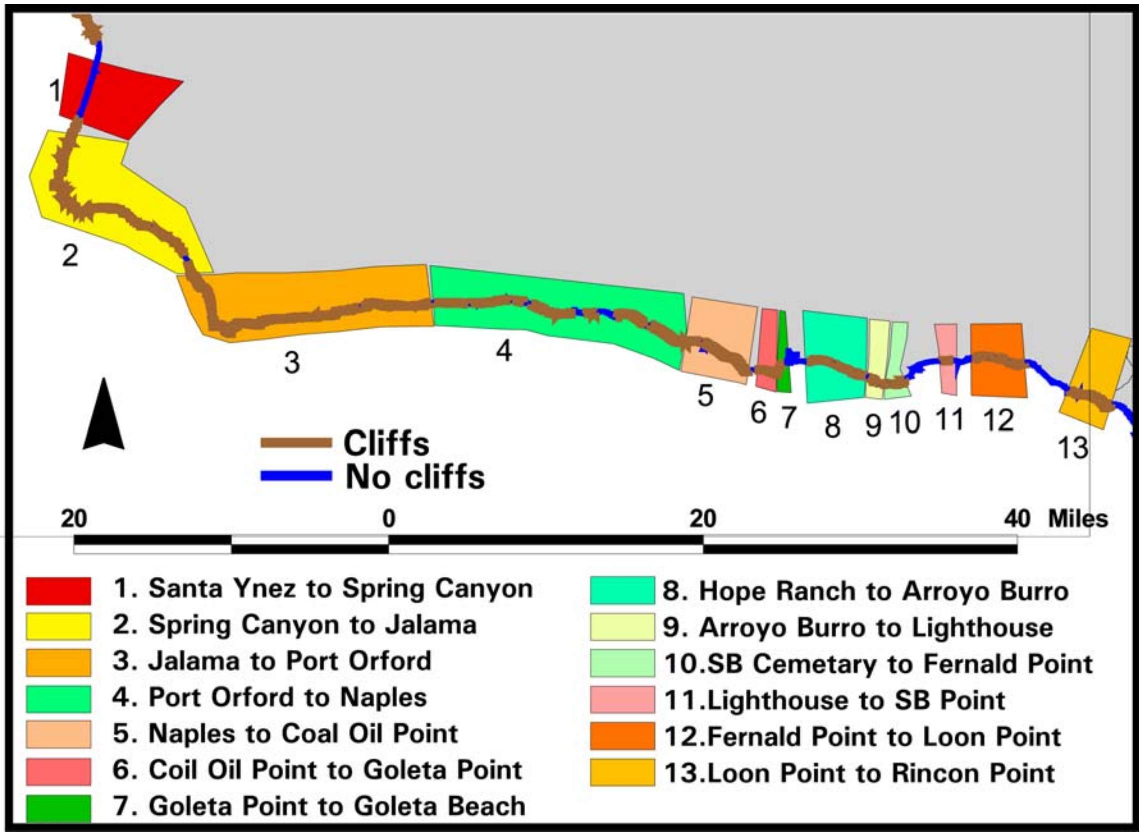


*Figure 11 Presence of Sea Cliffs in Santa Barbara Cell (Runyan, 2001)*

In the Oceanside cell, the cliffs are composed of sandstone, which, when eroded, yields a higher percent of littoral-size material than the cliffs in the Santa Barbara cell. For the Oceanside littoral cell stream input contributes 28 percent, bluff erosion contributes only 12 percent and Gully erosion contributes the remaining 60 percent.

In this cell, bluff erosion contributes 11.6 percent of the sand to the overall littoral budget; thus, bluff erosion could be consider a significant contributor in some areas of this cell and future armoring proposals need to fully evaluate impacts on sand production (Runyan, 2001).

**Table 1 Sediment inputs for the Oceanside and Santa Barbara littoral cells (Runyan, 2001)**

| OCEANSIDE LITTORAL CELL | | | |
|---|---|---|---|
| Inputs | Natural (cy/yr) | Actual (cy/yr) | Reduction (cy/yr) |
| Rivers | 286,500<br>44.7% | 132,500<br>27.9% | 154,500<br>53.8% |
| Bluff Erosion | 67,300<br>10.5% | 54,900<br>11.6% | 12,400<br>18.4% |
| Gullies/Terraces | 287,000<br>44.8% | 287,000<br>60.6% | 0<br>0.0% |
| Total Littoral Input | 641,500<br>100.0% | 475,100<br>100.0% | 166,400<br>26.7% |
| Santa Barbara Littoral Cell | | | |
| Inputs | Natural (cy/yr) | Actual (cy/yr) | Reduction (cy/yr) |
| Rivers | 3,642,773<br>99.6% | 2,167,000<br>99.5% | 1,475,773<br>40.5% |
| Bluff Erosion | 14,028<br>0.4% | 11,312<br>0.5% | 2,716<br>19.3% |
| Total Littoral Input | 3,656,801<br>100.0% | 2,178,312<br>100.0% | 1,478,489<br>40.4% |

## Southern California Beach Processes Study

Torrey Pines Beach, located at the border between the cities of San Diego and Del Mar, was nourished in April 2001 with about 250,000 cubic meters 328,947 cubic yards) of sand that was deposited on the beach above the low tide level and over a 500 meters (1,640 feet) alongshore span. Wave and beach profile measurements began in March 2001, and will continue for the following 2 years.


*Figure 12. Torrey Pines Project April 2001 (Seymour, 2001)*

This project will combine techniques for determining wave characteristics accurately at closely spaced intervals along a large region of the California coastline with a prediction of the resulting sand transport along and across the beach at the same intervals. When used with a sufficiently long history of the offshore waves, this methodology can provide a number of useful products:

- ❖ Site-specific wave height occurrence data for structural design criteria.
- ❖ Prediction of short and long term effects of proposed projects on beaches in the region, including beach nourishment plans.
- ❖ By combination with data on tides, prediction of site-specific flooding potential and maximum wave up-rush
- ❖ Data on wave driven currents to support water quality studies.
- ❖ Availability of the data sets to coastal engineers and regulators through the Internet in a standard, recognized format to reduce the costs substantially for designing, planning and permitting proposed projects.

The Coastal Data Information Program (CDIP), operated by Scripps Institute of Oceanography (SIO), makes offshore wave measurements along the West Coast of the United States. CDIP has also developed the methods for modeling how these waves are changed by island blocking and refraction by ocean floor contours as they propagate towards the beach. These modeled waves are presented on the Internet, updated several times each day, and are typically viewed by between 20 and 90 thousand individuals each day. The historical measurements, some dating back to 1976, are also available on this same web site. CDIP is an arm of the Center for Coastal Studies (CCS) at SIO. CCS has been involved for decades with almost every aspect of the measurement and prediction of coastal processes, including sand transport and the hydrodynamics of surf zones

The creation of the capabilities and the data sources that this project will provide could bring substantial benefits to California and the nation.

- ❖ It will provide a source of unbiased engineering data on what wave climate can be expected at very precise locations, eliminating the reliance on single values spanning many miles of coastline. This will result in safer designs in heavily impacted areas and eliminate the costs of over design elsewhere. It will eliminate the burden of ad hoc investigations for each proposed project impacted by waves and will provide permitting agencies, such as the California Coastal Commission, with reliable tests of reasonableness in evaluating permit applications.
- ❖ It will test the best available predictions of the effects of the wave climate on sandy beaches. As sand transport modeling capabilities improve, the underlying wave data are being accumulated such that these models can be economically evaluated.
- ❖ It will allow both proponents and opponents of proposed projects access to unbiased estimates of the highest obtainable engineering validity.
- ❖ It will provide easily acquired and readily understandable data that will support investigations in many other fields -- most particularly those concerned with ocean water quality, recreation, habitat restoration and other aspects of living resource management.

- ❖ It will provide a blueprint or template for adapting this technology to other states or coastal nations. (Seymour et. all, 2001)

**Rindge and Matilija Dam Removal**

*Rindge Dam*

In July 1998, the USACE conducted a Section 905(b) Reconnaissance study for Malibu Creek, California. The purpose of this study was to determine if there is a Federal interest in restoring ecological conditions along Malibu Creek, which has been obstructed by Rindge Dam and other barriers restricting the migration of steelhead to the upper watershed and the natural sediment flow.

The study evaluated the existent conditions with respect to removal of Rindge Dam and its reservoir's sediment accumulation and examined potential beneficial uses of impounded sediment to nourish the downstream beaches to protect development from coastal storm damage.

Rindge Dam is located in Malibu Creek, approximately 4 kilometers (2.5 miles) upstream from the Pacific Ocean coastline. Malibu Creek and its tributaries are located approximately 48 kilometers (30 miles) west of downtown Los Angeles, California. The drainage area covers approximately 28,231 hectares (109 square miles) of the Santa Monica Mountains and Simi Hills.

Rindge Dam was built between April 1924 and January 1925 by the Rindge family to store 708,018 cubic meters (574 acre-feet) of water for agricultural irrigation. The dam is a concrete arch structure 30.48 meters (100 feet) in height with an arch length of 53 meters (175 feet) at its crest and 29 meters (95 feet) at its base. The dam became subject to State jurisdiction for safety following passage of legislation in August 1929. Construction of the dam has obstructed the natural flow of Malibu Creek. Heavy silt loads in the creek resulted in sediment deposition in the reservoir, which was completely filled with sediment by the late 1950's and therefore, became useless as a water storage reservoir. The amount of sediment stored behind the dam is estimated to be between 611,644 cubic meters (800,000 cubic yards) and 1223288 cubic meters (1,600,000 cubic yards).

The Los Angeles District recommended that the study proceed with a cost-shared feasibility study of ecosystem restoration and related purposes subject to a non-Federal sponsor indicating their willingness to provide cost-sharing requirements. A Project Management Plan was developed and coordination with interested parties will continue during the reconnaissance study to assist arranging for the non-Federal sponsor and cost sharing for this project. (USACE 1998).

*Matilija Dam*

In August 2000, the USACE conducted a Section 905(b) reconnaissance study for Matilija Dam. The purpose of the study was to determine if was Federal interest in participating in a cost shared feasibility phase study to evaluate environmental restoration improvements to the Ventura River in the vicinity of Matilija Dam. In response to the study authority, the reconnaissance study was initiated February

2000. The reconnaissance study has resulted in the finding that there is a Federal interest in continuing the study into the feasibility phase.

*Figure 13 Matilija Dam (USACE, 2000)*

The study area is located on Matilija Creek, a tributary to the Ventura River, near the town of Ojai, in Ventura County. The dam itself is no longer functional as a water supply structure, and is identified as a major impediment to the natural flow of Matilija Creek.

Matilija Dam was built in the 1940's to provide water storage for agricultural needs. The dam is located in Matilija Creek, a tributary of the Ventura River, approximately 25.7 kilometers (16 miles) upstream from the Pacific Ocean coastline. Matilija Dam is a concrete arch structure 57.9 meters (190 feet) in height with an arc length of 189 meters (620 feet) at its crest. Silty material carried by Matilija Creek deposited behind the dam, filling the reservoir with sediment, deeming the structure useless as a water storage facility. It is estimated that 4,587,329 cubic meters (6,000,000 cubic yards) of sediment lies trapped behind the dam.

If no action is taken to secure passage for the steelhead trout to reach the upper watershed and its tributaries, the dam will continue to obstruct this endangered species, thereby limiting the amount of spawning and rearing habitat available. In addition, the dam would continue to act as a barrier for wildlife movement for other terrestrial and aquatic species.

It is also expected that if the Ventura County beaches are not nourished, they will continue to erode and experience additional storm damages. In addition, removal of the sediment from behind the dam could provide an estimated 2,280,000 cubic meters (3,000,000 cubic yards) of beach nourishment for Ventura County beaches. The final study recommendation was for the Matilija Dam Feasibility Study to proceed into the feasibility phase. (USACE, 2000)

## *PRODUCTS/COURSE OF ACTION FOR FY03*

1. Continue partnership with the State to gain congressional support and cost sharing.
2. Continue evaluation of impacts of dams and flood control channels on sediment transport to the coast.

3. Continue data collection efforts to obtain long-term records of regional beach response and accompanying wave data to validate regional scale models for sediment transport by waves.
4. Develop a coastal database that will be compatible with GIS databases developed by other regional stakeholders to allow easy transfer of knowledge. Integrating the coastal GIS database
5. Obtain, understand and predict regional wave fields and corresponding beach response to validate regional sediment transport models.
6. Initiate a study to optimize the use of sediments dredged at coastal harbors for beach nourishment purposes. i.e. Ventura Harbor Back -Passing Study.

## *MILESTONES*

1. Development of a GIS and Internet Map Server (IMS) component and necessary technical studies ($375,000 in FY'03)
2. Initiate study on optimizing harbor dredge material for beach nourishment use (total study cost= $300,000; $50,000 in FY'03, can expend more in FY'03 if funds are available)
3. Initiate study on a conceptual plan to capture and reuse coastal sediments generally lost down submarine canyons ($50,000 in FY'03)
4. CA State Coastal Conservancy Study of ways to increase natural sediment supply to the coast including evaluation of materials trapped behind dams and in flood control channels ($150,000; Sept. '01)
5. Dept. of Boating and Waterways Oceanography Study Initiation ($1,000,000; '01)
6. Matilija Dam Feasibility (April '01); (total study cost= $3,000,000; Project partners: CA State Coastal Conservancy, Corps, Bureau of Reclamation, USGS, County of Ventura Flood Control District, Institute for Fisheries Resources, US Fish and Wildlife Service, Southern California Wetlands Recovery Project)
7. Rindge Dam Removal Feasibility Study ($375,000; '01; Project Partners: Corps, CA Dept. of Parks and Recreation, CA State Coastal Conservancy)

## ***FUNDING***

| Type | Fiscal Year ($, thousands) | | |
|---|---|---|---|
| | FY01 | FY02 | FY03 |
| DEMO Program | 95 | 95 | 475 |
| Leveraged | 2200 | 3000 | 3000 |
| TOTAL | 2295 | 3095 | 3475 |

REFERENCES:


- Brooke, Col. Mark M. 1934. "Shore Preservation in Florida," with discussion, Shore and Beach, 2(4), 151-154. (http://216.83.232.123/history_of_rsm.htm)
- Coastal Sediment Management Workgroup 2000. "Initial Report"
- Coastal Sediment Management Workgroup. "Master Plan scooping document 2001" draft?
- Kenzer, M. S., D. J. Sherman, R. A. Runstrom, and B. O. Bauer. 1992 "California Landscapes" Rutgers University Press. New Brunswick, New Jersey. 328 pp.
- King, P. and M.J. Potepan. 1997 (updated 1999). The Economic Value of California's Beaches. Report submitted to the California Department of Boating and Waterways, Sacramento, CA. Public Research Institute, San Francisco State University, 40 pp.
- Runyan, K. 2001. "Contributions of Coastal Cliff Erosion to the Beach Sand Budget in California and the Effects of Armoring" Abstract submitted to "Restoring the Beach, Science, Policy and Funding" CSBPA-CalCoast 2001 Annual Conference, San Diego, California, November 8-10.
- USACE 1998. Reconnaissance Study Section 905 (b) (WRDA 86). " Analysis of Malibu Creek, California"
- USACE 2000. Reconnaissance Study Section 905 (b) (WRDA 86). "Matilija Dam"
- Seymour R., R. T. Guza, O'Reilly W., Elgar, S. " Southern California Beach Processes Study: Torrey Pines Project " Abstract submitted to "Restoring the Beach, Science, Policy and Funding" CSBPA-CalCoast 2001 Annual Conference, San Diego, California, November 8-10.
- Sherman, D. J., C. Avendano, K. Barron, J. Ellis, M. Lange and I. Mack 2001. "Impact of Dams on California's Coastal Sediment Supply" Abstract submitted to "Restoring the Beach, Science, Policy and Funding" CSBPA-CalCoast 2001 Annual Conference, San Diego, California, November 8-10.
- The Primacy Group. 1998. Public opinion poll concerning lack of sand on beaches in the City of Encinitas, CA. Report submitted to La Paz County Landfill, Parker, AZ, by The Primacy Group, San Diego, CA.


WEBSITES:


- http://216.83.232.123/laws_&_regulations.htm
- http://biology.usgs.gov/s+t/SNT/noframe/ca162.htm
- http://www.dof.ca.gov/HTML/FS_DATA/HistoryCAEconomy/index.htm
- http://www.calinst.org/pubs/bop2000.htm